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MONTHLY REVIEW

Published by the

American Electroplaters Society

Publication and Editorial Office

3040 Diversey Ave., Chicago

VOL. XVI NOVEMBER, 1929 No. 11

EDITORIAL

This month is one in which we celebrate our annual and memorial Thanksgiving that is so sacred in the history of our country, and should be likewise in our Society.

Much has been accomplished by this Society since its institution and similarly to our Pilgrim ancestors, and with many sacrifices to the pioneers of this organization. Yet in the great progress and strides of our industry, are we not prone to forget to be thankful for the foresight of the great men who so valiantly fought to promote our welfare by the organization of the American Electro-Platers Society, with its unselfish and high ideals.

In previous editorials there has been much said about research and help to the industry, and it is surely in keeping with the original ideas of our founders; but we, as members of the Society, are also entitled to many congratulations, for our insight to their thoughts, and the earnestness with which we have continued to carry on.

Your editorial staff thanks you all for your kind indulgence; and hopes that our offerings have been received with the spirit they are offered, purely educational, and if you do, well it's a real Thanksgiving for all of us.

DETROIT CORRECTION

October 25, 1929.

Mr. H. J. Jameson
Detroit Testing Laboratories
554 Bagley St.
Detroit, Mich.

Dear Mr. Jameson:

I have seen a copy of the article on the determination of boric acid in plating baths, as published in the monthly REVIEW of the American Electroplaters Society, Vol. 16, No. 8, for August, 1929.

The correction of which I spoke the other evening should be as follows: In the last line at the bottom of page 9, after the words: "bromthymol blue" should be added "and 5 g. of mannitol.".

I am writing to you because I think you will know the proper person to insert a correction in the next publication of the Society.

Very truly yours
H. H. WILLARD.

Editor: "This was an omission by author on the original paper."

SOME OBSERVATIONS ON CHROMIUM PLATING

By E. D. Bedwell, Los Angeles Branch, A. E. S.

As I am a practical plater and not a chemist, in this paper I will not attempt the use of chemical or technical terms, but will endeavor to give in the platers' every-day language an outline of our experiences and conclusions during the past 18 months of the more or less successful operation of a chromium solution.

The first and most important thing I believe in chromium plating is the cleaning of work for nickeling before chrome plating, as we all know that chrome is only as good as the deposit of nickel underneath. The most essential thing in cleaning brass or copper for a chrome resisting nickel is a medium strength cleaner that will not tarnish but will still clean (and there are several such

cleaners on the market) then dip directly into clean muriatic acid (no water in this dip), rinse in clean water, cyanide, rinse and into your nickel with as little delay as possible to avoid any chance of stain or oxidizing.

Secondly, the nickel bath should be of the single salts, Epsom salts and salamoniac variety, very low in acid, and current should be run very low (I should say not more than half the current the average plater uses ordinarily for nickel plating), so as to obtain the very softest deposit possible.

If these two rules are observed very closely we have found little or no trouble with chrome pulling the nickel; and as I will explain later we have had an excellent opportunity to observe the action of chrome on different nickel deposits.

Third, we come to the chrome bath itself, and the operation of same. We have carried on experiments for the past three years with a number of different chrome baths and about 18 months ago we arrived at the conclusion that very good results were to be had from the very common formula of chromic acid and sulphuric acid in the proportion of about 100 to 1, and let me say right here that we have found that about, is as near as you can give proportions, as in some cases we have only been able to use 1½ oz. of sulphuric to 100 lbs. of chromic acid. The proportion of sulphuric to be used, however, may readily be determined by the bent cathode test, which we are nearly all familiar with by now.

For the benefit of those who are not familiar with the test I will refer to the paper on the bent cathode test by W. L. Pinner and E. M. Baker in the September issue of the monthly REVIEW.

We have had the best success with a chrome bath having 3 lbs. chromic acid to the gallon, but very satisfactory results may be had with 2 lbs., and here let me say that if you make your bath up with 3 lbs. to the gallon you must maintain it at that for best results because the sulphate is not used out of your solution in anywhere near the proportion that chromic acid is, therefore you must make frequent addition of chromic acid without the addition of sulphuric, and in no case should sulphate be added without first making a test as it is very easy to add but practically impossible to remove. However, if you do get too much sulphuric there are several ways to adjust that condition. Obviously you may add more chromic acid, which will reduce the proportion of sulphate to chromic acid, or you may remove part of your bath and add

water and chromic acid enough to incraese the gravity of original point or you may add barium carbonate. None of these should be added until you have made a test in small solution to determine amount required, and then add to or reduce your large bath in proportion.

In regard to the use of barium carbonate for the reduction of the excess of sulphates in a chrome bath we have found by a number of very careful tests that the striking in power of the bath will never be quite as good as it was before the use of barium. Personally, I would not recommend the use of it, but the more simple method of adding chromic acid or if the excess of sulphuric is too great the reduction of the bath with water and then addition of chromic acid.

The regulation of current is also a very important factor in obtaining a bright uniform deposit of chrome, especially in lower temperature baths is this true, because the cooler baths have a slower cleaning power. Incidentally, the tendency is downward in the last year in regard to the temperature of the bath. Several platers I have talked to lately that are operating the better known patented baths, tell me they are instructed to run the bath at about 100 degrees and we are operating ours at very much lower degree than that.

The current should be started about 1½ to 2 volts and gradually advanced after about 15 seconds to 5 volts in case of small easy work to strike in on; but on large difficult pieces, 7 to 9 volts if you have it. I wish to explain here that I talk in voltage, because I practically never read the ammeter for the very simple reason that I found that at a certain voltage, regardless of amount of work in the bath I got a certain result, and I didn't have to figure the surface to be covered.

Last I believe in importance are the anodes, as there are a number of different metals that may be used with about equal satisfaction and results. Nickel, lead, chrome and iron are some of them, and there seems to be considerable difference of opinion as to which are best. Our experience along this line is this: we started in 18 months ago with lead anodes in a 200 gallon bath at 120 to 130 degrees and used them about three weeks. At the end of this period we had come to the conclusion that even if iron anodes did ruin our solution in three months, as we had been told it would, we would still be ahead of the game to throw it out

and make a new one, as we had taken our lead anodes out at least twice a day to clean them and then if we had a large piece of work we could not get current enough to plate it. Accordingly, we put in iron anodes and have had them in the solution ever since. About three or four months later we reduced our temperature to about 90 degrees and have since run at that or cooler. We are still getting a bright uniform deposit from this bath, with at least 95 per cent of the striking in power of a bath we made up in the last two months and also know others that have run a year or more with iron anodes with the same results.

In closing I wish to refer to the nickel subject again. We are doing chrome for 8 to 10 different plating shops and have found that the nickel done by some of them almost always stands up under a chrome plate, while others in nearly every job have some that peels. This, I think, is because of carelessness mostly in cleaning the work for plating, as if it was trouble in the bath itself or in regulation of the current the whole job would peel off in the chrome.

So, if you are having trouble with your nickel peeling when being chrome plated, look first to your cleaner, second to your current and last to your nickel bath.

PAPER BY BENJAMIN FOSS

Los Angeles Branch

In the plating of aluminum, great care must be taken with the nickel solution to keep it in a neutral state.

The following formula for nickel solution is advised:

Double nickel salts	8 oz.
Common salt	2 oz.
Sodium citrate	2 oz.
Magnesium sulphate	2 oz.
Water	1 oz.

This solution will show a strong acid reaction and must be brought to a neutral state by the addition of nickel carbonate and kept in that condition. The best way to keep it in that state is to hang the carbonate in a muslin bag. Just keep adding the carbonate as it is needed. This is really a die casting solution.

In cleaning the work first—use no caustic cleaner. Use a hot soda ash for a few minutes, then use the following dip for a few seconds:

Hydrofluric acid .....4 oz.
Water .....1 gal.

This will remove all oxides from the surface, then scour with lime paste and rinse with water. Then allow to remain in the following dip about one minute:

Muriatic acid .....2 oz.
Iron chloride .....6 oz.
Water .....1 gal.

This dip must not be rinsed off. Just swing it dry. Then into the nickel solution—it must be struck heavy and quick—then turn down the current and plate normal, after which you can plate any plate you wish.

THE THICKNESS OF PLATED METAL COATS

(Presented to the Detroit Branch, A. E. S., Oct. 5, 1929)

Since the advent of chromium plating, the plating profession has become aware that any information which increased the efficiency and quality of a plating bath was important. With the use of scientific data, plating shops have speeded up production and improved the apearance of their goods. Likewise, the buyers of plated goods have realized that a noticeable difference exists between the best plated ware and the ordinary or poor goods, and they have set about to draw up specifications as to the amount of plate they desired and as to the corrosion resistance of the plated articles they were buying. Guesswork fails in gauging the thickness of a plate, but the importance of knowing the thickness is evident since the acceptance of a shipment of work may depend on meeting thickness specifications.

Knowledge of the thickness of metal plated enables a plater to test the efficiency of his bath, and also to determine the limits of the working of a bath which should be wide.

Faraday's Law states that the amount of a metal deposited is directly proportional to the current passing through a solution, that is, double the amount of current should double the amount of deposited metal. By means of this law, the table of electrochemical equivalents has been calculated, which gives the amount of any metal deposited by one ampere of current flowing for one second. Such tables have now been elaborated to include such

information as grams and ounces or pounds of metal per ampere hour. All such data is based on 100 per cent efficiency.

The terms frequently used in specifications are ounces per square foot, thickness in fractions of an inch, and ampere minutes of plate per square foot. The first two are not puzzling; the last term signifies the equivalent of the metal deposited in terms of the current used and the length of time plated, in other words, the amperes multiplied by the minutes of current flow. Thus, 200 ampere minutes can mean 10 amperes for 20 minutes, or 20 amperes for 10 minutes.

Should a square foot of metal cathode be carefully weighed and its thickness measured before plating, and the current and time of plating noted, followed by reweighing and remeasuring the thickness, there would be possessed all the factors for determining the weight of plated metal per fraction of an inch thick per square foot of surface, and also the data for calculating the efficiency of the bath and the ampere minutes of metal plated. In many instances, such determinations are made in laboratories to establish the weight of metal per 0.001 in. per square foot of surface. However, without much time or trouble expended, such a relation can be calculated from data on the metallic elements already acquired and found in scientific handbooks.

Using the data on the metal chromium, the above relationship can be calculated as follows. The specific gravity of chromium is 6.92, that is, it is 6.92 times as heavy as water, which weighs 62.34 pounds per cubic foot. A simple multiplication gives the weight of chromium as 431.43 pounds per cubic foot. To simplify the calculation one must imagine a cube one foot square on all sides and one foot high. The base is equal to one square foot and by dividing the above weight by 12, the weight of a mass one inch high and one foot square is obtained, which is 35.95 pounds. To obtain the weight of one square foot of metal 0.001 in. high, 35.95 is divided by 1000, resulting in 0.03595 pounds of chromium per .001 in. per square foot of area, or 0.575 ounces per .001 in. per square foot. By experiment or calculation, the above relationship can be secured for any metal.

The actual determination of the thickness of plate on a production sample is accomplished either by direct measurement or by chemical analysis. It is fairly easy to produce a non-adherent plate, which can be stripped from the base metal and measured with a micrometer, and a piece of definite size weighed.

To produce non-adherent plate on colored brass or copper, dip the test piece in chromic acid before nickel plating. On die castings, dip the piece in the cleaning tank, followed by a quick rinse before plating; an alkaline film is left on the casting which produced a non-adherent film of plat, and which is easily loosened from the base metal by reversing the current on the sample in a cleaning tank. Oxidizing dips on copper and brass and possibly on steel, will produce subsequent non-adherent plates. Tincture of iodine will serve in silver plating. Also one can buy solutions for such a purpose in the market. The production of non-adherent coats of chromium, cadmium, copper and zinc plates is not so general, and most usually the determination of the thickness of these metals is a laboratory procedure.

To determine the thickness of plate by analysis, a piece is cut from the sample submitted and its area carefully measured. If plated with Chromium, Nickel and Copper, the thickness of all three can be obtained from one sample. The plated section is placed in a beaker and covered with concentrated sulphuric acid. The dissolving of the Chromium begins at once and with the addition of a very small amount of water, the Chromium is dissolved off completely, leaving the nickel untouched. The sample is washed and allowed to dry, and placed in another beaker, and concentrated nitric acid added with a few droys of concentrated sulphuric. The action is slow to start but small additions of water hasten it and soon the nickel and copper are dissolved, leaving the base metal clean. In the case of non-ferrous base metals, the dissolving of small amounts of zinc and other constituents is possible, as iron is dissolved from a steel base. Water must be used very sparingly, since concentrated acids have only a slight effect on the base metals, while dilute acids act rapidly.

The Chromium is determined analytically by electrometric titration with ferrous sulphate after oxidation. The copper and nickel solution must have the iron removed by precipitation with ammonium hydroxide. The copper is then determined by plating analytically from the mixed solution slightly acid with nitric acid. The nickel remains in the solution and is determined by titration with potassium cyanide in a slightly ammoniacal solution.

Cadmium is easily stripped with nitric acid, and determined from a solution made alkaline with sodium hydroxide and sodium cyanide, by analytical plating.

An ingenious test for Chromium plate is in use in several laboratories. Concentrated hydrochloric acid will dissolve Chromium

but not Nickel and the chemical action results in bubbles of hydrogen being evolved as long as the metal is being acted upon. If the same acid is used and the drop of acid is of the same size, the amount of Chromium dissolved is proportional to the length of time the bubbles indicating reaction are observed. The relation between ounces per square foot and thickness of plate to seconds of reaction has been determined so as to provide an accurate test. A drop of acid is placed on the sample and the instant bubbles are observed a stop watch is started, to be stopped the instant the bubbles cease. The seconds are recorded and by reference to a table the thickness and weight of the Chromium plate is obtained. The table for this test is an arbitrary one and must be determined for standard conditions of the test. This test could possibly be applied to zinc and cadium plating.

The results of all analysis in a laboratory are in grams, which are easily converted to ounces, and by dividing the ounces of metal determined by the area in square inches of the sample, the ounces per square inch are obtained. Multiplying by 144 the figure becomes ounces per square foot. Referring to tables or previous calculations we find that the weight in ounces per .001 inch per square foot is .575 for Chromium, .742 for Nickel, and .747 for Copper. By dividing the weight of plate determined in ounces per square foot by the above number the thickness is obtained.

From the table of electrochemical equivalents the weight of a metal deposited by one ampere minute is obtained, and by dividing the weight per square foot of plate on the sample by this figure the ampere minutes necessary to deposit that weight are secured. In the case of Nickel or Acid Copper solutions, whose efficiencies approach 100% this figure is correct as obtained. In the case of Chromium with an efficiency of about 13% or Cyanide Copper of about 47%, the result must be divided by .13 or .47 to obtain the correct result. The result is expressed in ampere minutes per square foot of plated surface.

Various tables are published on the relation of ampere minutes per square foot to the thickness of metal plated, and from these the ampere minutes necessary to plate the metal of the thickness as determined, can be ascertained. One of the most complete and correct tables was published by Baker and Pinner in January, 1928, in an article on "The Protective Value of Chromium Plate," presented before the Society of Automotive Engineers.

A typical analysis of Chromium over Nickel gave 0.011 ounces

per square foot. The table of electrochemical equivalents gives 0.00019 ounces of Chromium per ampere minute. By division, 57.9 ampere minutes is obtained, which would be correct at 100% cathode efficiency. Since the efficiency is about 13.3%, another division by .133 gives 435 ampere minutes of Chromium per square foot. If the thickness is to be determined, the weight 0.011 ounces per square foot is divided by 0.575, giving a result of 0.019. Since .575 is the weight per .001 inch per square foot, 0.019 must be multiplied by 0.001, and the thickness of the plate is 0.000019 inch. From a perusal of tables on thickness and ampere minutes, we find 0.000019 is equivalent to 435 ampere minutes per square foot.

The specifications of one automobile plant in Detroit are, Chromium, 0.00002" thick and 0.01175 ounces per square foot; Nickel on steel base, 0.20 ounce per square foot and on non-ferrous base, 0.10 ounce per square foot.

Typical analyses of the plating produced by one shop in Detroit are as follows:

	Oz., sq. ft.	Inches thick	Amp. min.
Ni over cu on steel.....	0.350	.00034	370
Ni on die cast.....	.138	.00018	200
Cr. over Ni on die cast...	.011	.000019	435
Ni on brass.....	.101	.00013	153

General practice calls for about 300 ampere minutes of Nickel and between 400 and 500 ampere minutes of Chromium.

If the time of plating is known and the ampere minutes calculated, the current density is obtained in amperes per square foot by dividing the ampere minutes per square foot by the time in minutes. The current density on a production tank can be roughly calculated from a knowledge of the total square feet of cathode surface and the current flowing, but such a figure does not usually include racks and wires. From the data on thickness of plate, the actual current density on the plated article is obtained, and the knowledge as to whether a bath is operating at its best current density is obtained.

Also, from a knowledge of the ampere minutes of plate on an article and the ampere minutes actually put into the tank, the loss on the racks and wires can be calculated. It follows then, that the current necessary to plate at a certain current density can be calculated from the per cent of ampere minutes actually going on the work.

With data on the ampere minutes of plate per square foot and ampere minutes actually put into the tank, the efficiency of a bath can be calculated. Suppose one square foot of surface to be plated with chromium at 100 amperes per square foot current density for three minutes, and the resultant plate found to be 0.0074 ounces per square foot in weight. From the tables it is ascertained that one ampere minute of chromium per square foot at 100 per cent efficiency weighs 0.00019 ounce. This figure multiplied by 3×100 or 300 ampere minutes is 0.057 ounce. The actual weight determined, 0.0074 ounce, is divided by the weight at 100 per cent efficiency, and the result is 0.13, which multiplied by 100 is 13 per cent, which is the efficiency of the bath.

In conclusion, I would impress on you that a knowledge of the thickness of plate is important, and has many applications which lead to economy, efficiency and a more complete understanding of the working of a plating bath.

O. A. STOCKER,
Bohn Aluminum & Brass Corp.

CHROMIUM PLATING

By George B. Hogaboom

Past Pres. A. E. S.

Chromium deposition has taken its place so firmly in electroplating that any discussion of electroplating principles is not complete unless it includes chromium. The adoption of chromium plated goods was so rapid that it was thought at first that entirely different principles governed its successful deposition. This led to a large number of investigations, the results of which, after summing up, indicate that not one new fundamental principle of the electrode deposition of metals has been established. It is true that the operating conditions under which good chromium deposits could be obtained were different in many ways from those generally used for the deposition of other metals. It is also true, now that those conditions are better understood, that if those very same methods of operation had been in use, for example, for nickel plating, a great deal of the mystery that surrounded chromium plating could not have existed; and, what a tremendous amount of grief would have been avoided! This grief was caused only indirectly by the advent of chromium

plating; the real cause was the lack of knowledge of some of the basic principles of the electrodeposition of the common metals, most of all, the hesitancy to put into commercial practice what was already known. Manufacturers and platers both had been spoiled by the success of rule-of-thumb plating. It took the new schoolmaster, Chromium Plating, to make us get out of the rut and dig deeper into the "and how" if we were to pass inspection and satisfy production. Like in all schools, school of experience being no exception, there are some who only skim over the pages and just about get by. Unfortunately their work is sometimes held up as an example of chromium plating and the manufacturer and the public shake their heads in distrust as to the future of chromium deposits. This is really unfortunate and oftentimes the blame is more that of the manufacturer than that of the plater for not realizing that good work costs less than poor work and that to do good work it requires good equipment. Good chromium deposits can be had and eventually those doing good work will prevail. Standardization of the methods and of the quality of production and sincere cooperation rather than threats of using other metals will bring about better chromium plating.

READ AT THE SMOKER MEETING, LOS ANGELES BRANCH, OCTOBER 9, BY FRANK C. RUSHTON

Mr. President, Visitors and Fellow Members—Eliza asked Sam: "Tell me, honey man, wuz yo' cool when dem big shells commenced to busting over yo' head in dat trench?"

Sam: "Cool? Sugah lump, Ah was de coolest nigger what ever was cool, Honey. Ah shivered." That's how I felt, gentlemen, when I was asked to make the opening talk for this, our first smoker.

Some 50 years ago there was very little plating done. The platers those days mostly made their own supplies, metal salts, buffs, wheels, composition lacquers, etc., and used batteries, where today we have up to date supplies and generators. The demand for protective coatings and finishes for metals increased so fast that today one cannot go into church, bank, office, house or anywhere without seeing metal articles plated or of beautiful finish. Naturally, this condition created a demand for platers and probably a man who perhaps had worked as a plater's helper would get a job somewhere else to call himself a plater, yet what could he

be expected to know? Result was, he would struggle along and experiment at the boss' expense and if he did learn anything, he would guard his knowledge and surround his work with mysteries.

Twenty years ago a small group of platers were gotten together by Chas. H. Proctor, and they formed the American Electroplaters Society for educational purposes and to exchange knowledge. Today there are some 1350 members in 25 cities. The Society is officered by active members, gratis, who do the work in their spare time. The editor of the REVIEW only, received a nominal salary. This REVIEW is published and mailed monthly to members and certain results of discussions and papers covering not only plating, but every phase of the industry and production methods. It is literally a gold mine of information to the plater.

Also this book of papers read at a recent convention contains information no one plater, electroplater or scientist could write.

Most Eastern branches have chemistry classes two or three evenings a week during the winter months. Result has been that some platers have graduated into electro chemists, with subsequent substantial benefits to themselves. Others have learned the laws of electro chemistry all to the benefit of plater and his employer.

We hope to have a class in chemistry. Mr. Boeck has kindly volunteered his services in explanning symbols, equations, valences, etc., and fundamental laws of electro chemistry, so that when we make an addition to a solution we will know what it does and why we do it.

The American plater today is recognized as the most efficient in the world. It is necessary we maintain this supremacy, as Japan, China and other countries, with cheap labor, are in the field and expanding rapidly. Recently a 20,000 ampere plating generator was shipped to Belgium. We can overcome foreign competition by modern methods.

A short time ago a few of the platers in Los Angeles (and we have some of the best) started this branch. It was decided upon receiving our charter from the Supreme Society to celebrate by having this smoker, to which we could invite the employer and representatives; also those interested in the art of electroplating, including platers who have not yet joined. We want you to know what this Society is, its objects and aims, so we can be assured of your co-operation.

It has generally been considered that the plating department was

but a small item in the factory or job shop. That is true, as compared to labor numbers and cost of other departments, yet it is one of the most important, because after all, it is the final finish of the product that the customer sees, and that gives it the stamp of approval and merit. We have endeavored to furnish a few papers tonight that would be interesting to our visitors and at the same time be instructive to all.

I don't have to tell you how glad we are to have you with us and we hope this will be the first of many pleasant meetings and sometime in the future we hope to have an affair to which we can invite the ladies.

In conclusion, I would like to quote the esteemed founder of this Society, Chas. H. Proctor.

If you are an intelligent plater you do not have to spend years in the study of chemistry, or electricity, or mechanics, to be a master of your art. Chemistry is a splendid factor, one of the greatest of sciences the world ever produced. Obtain a knowledge of its laws and apply it for your individual needs.

Listen not to the fellow who says, "It can't be done." He is interfering with your chance of success. He is dangerous. The fellow who doesn't know it cannot be done is very apt to wade right in and do it. When you come to think of it, all progress grows out of things which somebody says cannot be done. Keep your eye on the fellow who says it cannot be done. If you want his job, he is your oyster.

Gentlemen, I thank you, and hope you will enjoy the evening.

BALTIMORE-WASHINGTON BRANCH

The regular monthly meeting of the Baltimore-Washington Branch was held Saturday, Nov. 2, in the Enoch Pratt Library, Calhoun and Hollins streets, Baltimore. President M. J. Kraft presiding.

Dr. Blum explained to us the experiments of Lesson 2, on Chromium Plating, held in the Bureau of Standards, Washington, D. C., Oct. 26, after which we proceeded with our regular business. Communications were read.

One minute of silence was paid in respect to one of our fellow members, Mr. E. J. Hollis, who died very suddenly, Oct. 21. Following this, we discussed the forthcoming convention and banquet. Hotel Mayflower was selected as convention headquarters. Convention to be held June 30 to July 4. Fourteen members attended.

GEORGE F. TURNER, Secretary.

SPECIFICATIONS FOR A PLATERS' DINNER

H_2O

Brightener

Cadmium Sticks Oval Burnishing Balls

Chrome Solution—10° Beaumé

Walrus Hide

Liver of Sulphur

Verde Antique Bullets

Green Gold Leaf with Golden Sulphuret

Combination

Tripoli Pink Crocus White Finish Bar

Nickel Washers

Potash

Rolled Buffs Butter of Antimony

Silver Plated Coffin Nails

Metal Sodium Sticks

By Frank C. Rushton

THROWING POWER IN CHROMIUM PLATING

Report of H. L. Farber, Research Associate, American Electroplaters' Society, Detroit, July, 1929

I—Introduction

Although numerous authors have compared the throwing powers of different chromium plating solutions, as measured for example, with bent cathodes, no numerical data on throwing power have been previously published. The definition and methods used in this study are those described in previous papers from the Bureau of Standards.

II—Principles

(a) *Throwing Power:*

The throwing power is defined as the improvement in per cent, of the metal distribution ratio above the primary current ratio. If the latter is 2:1, and the metal ratio is 1.5:1, the throwing power is +25 per cent. If the metal ratio, however, is 3:1, the throwing power is —50 per cent. In chromium the throwing power is always negative. A value of —25 per cent is good, while one of —100 per cent is poor.

It has been shown that in all solutions the throwing power depends only on the cathode polarization, the conductivity and the cathode efficiency. In chromium plating the cathode polarization and conductivity have negligible effects. Hence the throwing power depends almost entirely on the relation of the cathode efficiencies at the high and low current densities used. If these cathode efficiencies were equal, the throwing power would be zero. Actually the cathode efficiency in chromic acid baths is always less at low than at high current densities. This causes negative throwing power. Thus, if the cathode efficiencies are 16 per cent and 8 per cent at the high and low current densities respectively, the throwing power is —100 per cent. The only way in which the throwing power can be improved is by making these cathode efficiencies more nearly equal.

(b) *Methods of Improving the Primary Ratio:*

As, at best, the throwing power in chromium plating is poor, it is desirable to so arrange the cathode and anodes as to have the current density on the cathodes as nearly uniform as possible. This can be accomplished in the following ways:

(1) Have the anodes and cathodes parallel or concentric.

(2) Have the cathodes a considerable distance from the anodes.

(3) Have conducting wires or rods connected to the cathodes so as to detract or "steal" the current from points that tend to get too high a current density.

(4) Use insulating shields to deflect the current from projecting parts of the cathodes.

(c) *Plating Range:*

In chromium plating it is especially desirable to obtain bright deposits all over the cathode, as it is usually difficult to polish dull chromium. For each solution there is a limited range within which bright deposits can be obtained. The selection of this plating range is often more important than the actual thickness of the deposits, as expressed by the throwing power.

(d) *Covering Power:*

The best cathode test measures the extent to which the cathode is covered. As will be seen, the results are practically parallel to the throwing power.

III—Methods of Study

The throwing power measurements were made in a glass-lined steel box. A platinum gauze anode was used, and polished steel cathodes were used in most of the tests. The primary ratio was 2:1. The cathode efficiencies were calculated from the currents used and the weights of deposits. The latter were classified as (M), milky, (Br) bright, (F) frosty, and (Bu) burnt, in order to define the plating range. The bent cathode tests were made in the same glass box, and the ratio of distances from the anode to the far and near parts of the cathode was also 2:1.

IV—Results Obtained

The data obtained in several hundred experiments will require numerous tables and curves for their complete presentation. In the following table a few typical results have been assembled in order to show the principal effects of the different conditions.

V—Conclusions

From these experiments the following conclusions were drawn:

1—The throwing power is determined almost entirely by the cathode efficiencies, and can be improved by making these efficiencies more nearly equal at the maximum and minimum current densities used.

2—At a given current density an increase in temperature reduces the throwing power.

3—At a given temperature, an increase in current density improves the throwing power.

4—Good throwing power and bright deposits can be obtained more readily at high temperatures and current densities than at low. A higher voltage is required however.

5—Dilute solutions of chromic acid give better throwing power for a given current density. As, however, their resistance is greater, a high voltage is needed. For a given voltage (e. g., 5 volts at the tank), better throwing power is obtained in the more concentrated solution.

6—A low content of sulphate, e. g. $CrO_3/SO_4=200$, gives slightly better throwing power than a ratio of 100, and much better than a ratio of 50.

7—Sodium dichromate, added in large amounts to a solution with a sulphate ratio of 100, slightly improves the throwing power, probably by changing the sulphate ratio. If the latter is 200, the addition of sodium dichromate is detrimental.

8—Boric acid has no appreciable effect on the throwing power.

9—Small concentrations of trivalent chromium have no effect on throwing power. High concentrations increase the throwing power, making it equal to that of a more dilute solution. As the resistance of the bath is thereby increased and the plating range decreased, trivalent chromium is not advantageous.

10—Iron has practically the same effects on throwing power as trivalent chromium, but a greater detrimental effect on the resistivity and plating range.

11—Polished metal surfaces yield better throwing power than rough surfaces.

12—The throwing power is slightly better on steel and brass than on copper and nickel.

13—The results for covering power on bent cathodes are practically parallel to the measured throwing powers.

14—The best throwing power (—13 per cent) with bright deposits, was obtained in a solution containing 250 g/L (33 oz/gal) of CrO_3, 1.25 g/L (0.17 oz/gal) of SO_4, at a temperature of 55° C (131° F.) and an average current density of 35 A/dm² (325 A/ft²). This required in the box, 6.4 volts. Such conditions

are suggested for use when a voltage above 6 is available, and when the best attainable throwing power is desired.

15—When the voltage is limited, and, e. g., only 5 volts is available at the tank, a good throwing power (about —30 per cent) can be obtained with 400 g/L (55 oz/gal) of CrO_3 and 2 g/L (0.27 oz/gal) of SO_4 at a temperature of 45° C. (113° F.) and an average current density of 15 A/dm² (140 A/ft²).

16—In the latter solution, at a temperature of 35° C. (95° F.) and an average current density of 7.5 A/dm² (70 A/ft²) a throwing power of about —60 per cent is obtained. This is usually satisfactory if the articles are not of very irregular shape, or are favorably placed in the tank.

TYPICAL THROWING POWER DATA

I—EFFECT OF TEMPERATURE AND CURRENT DENSITY
250 g/l (33 oz/gal) CrO_3; $CrO_3/SO_4 = 100$

Temp. °C	Temp. °F	Av. C. D. A/dm²	Av. C. D. A/ft²	Volts	Throwing Power %	Appearance Near	Appearance Far
25	77	5	47	3.9	—295	Bu	M
35	95	7.5	70	3.9	—108	F	M
35	95	15	140	4.8	— 58	F	Br
45	113	15	140	4.6	— 65	Br	Br
45	113	25	230	5.8	— 27	F	Br
55	131	25	230	5.5	— 46	Br	M
55	131	35	325	6.4	— 28	Br	Br
55	131	45	420	7.5	— 14	Br	Br

II—CONCENTRATION OF CrO_3
45° C (113° F); 15 A/dm² (140 A/ft²)

Conc. g/L	CrO_3 oz/Gal	CrO_3/SO_4	Volts	Throwing Power %	Appearance Near	Appearance Far
150	20	100	5.2	—50	Br	Br
250	33	100	4.6	—65	Br	Br
400	53	100	4.5	—85	Br	Br

III—CONCENTRATION OF SO_4
45° C (113° F); 15 A/dm² (140 A/ft²) 250 g/L (33 oz/gal) CrO_3

50	4.7	—154	Br.	M
100	4.6	— 65	Br	Br
200	4.7	— 52	Br	Br

IV—TRIVALENT CHROMIUM AND IRON
45° C (113° F); 15 A/dm² (140 A/ft²)
250 g/L (33 oz/gal) CrO_3; $CrO_3/SO_4 = 100$

CrIII g/L	CrIII oz/gal	FeIII g/L	FeIII oz/gal	Volts	Throwing Power %	Appearance Near	Appearance Far
0	0	0	0	4.6	—65	Br	Br
3	0.4			4.6	—64	Br.	Br
9	1.2			4.8	—57	Br	Br
17	2.3			5.5	—43	Br	Br
34	4.5			7.0	—29	Br	Br
		4	0.5	4.6	—71	Br	Br
		9	1.2	4.7	—56	Br	Br
		19	2.5	5.1	—55	Br	Br
		37	5.0	7.8	—37	F	Br
9	1.2	9	1.2	5.5	—58	Br	Br
1.3	.2	0.9	.12	4.6	—71	Br	Br

(Applause.)

CHAIRMAN O'CONNOR: Are there any questions you would like to ask Mr. Farber?

MR. J. HAY: I would like to ask the speaker if, when he made those tests, he cleaned the parts before plating or if they were done without cleaning.

MR. FARBER: They were all cleaned by the use of an electrolytic cleaner, that is, an alkaline cleaner.

MR. HAY: I will ask another question. Has the gentleman found the electric current used in electric cleaning before chromium plating has any effect on throwing power of a chromium solution.

MR. FARBER: No measurements of this kind were made, as far as I know. Probably in cast iron the effect would be negligible.

CHAIRMAN O'CONNOR: Any other questions,—

DR. BLUM: Just perhaps to start some more discussion, I want to call attention to the relation between this covering power test, these specimens passed around, and the results which Mr. Pinner reported this afternoon. I think it is an interesting development, we hope in the right direction, in that we find that last year, Mr. Sizelove reported the fact that he had used the bent cathode for comparing the throwing power of different solutions, and incidentally he reported that the low sulphate gave the better throwing power. Then, Professor Baker and Mr. Pinner, quite independently, used the bent cathode test under certain conditions, and used it to study and thereby to define, the best conditions of, or get the best throwing power.

Now we, of course, made use of all the information they had obtained, and what has been done in these experiments is to attempt to standardize the bent cathode test, because of course, if you hang a bent cathode in a beaker and you don't have it in exactly the same position in the beaker, or the beaker is a little bit better one time than the other, or the anode is a different size, you can't expect to get just exactly the same degree of covering.

Another thing, as I called attention to this afternoon in those experiments of Dr. Baker and Mr. Pinner, they used conditions under which the cathode could be completely covered rather easily; in other words, they would have a rather wide range of

sulphate ratio, or other conditions, in which it would be completely covered. Now we deliberately chose the conditions, putting the bent cathode in this box so as to fix it absolutely in position at a certain distance away from the anode so we are sure we get reproducible results, and we chose the size and position of the cathode so that it would be almost impossible to plate into the corner. In other words, you have to get the best throwing power shown in those cards, the amount is about —13 or —14 per cent, and with that it is not quite plated into the corner.

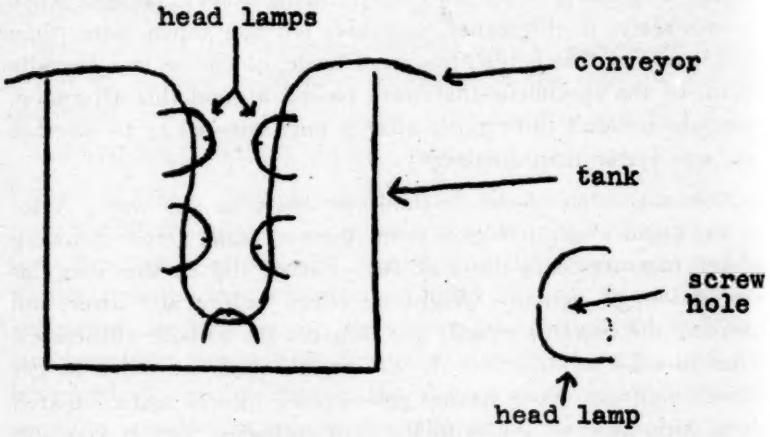
Now you see that is better than if the cathode plates in the corner with say a —50 per cent throwing power, because when it once plates in the corner, you can't tell how much better than that it is, and that is the criticism I made, of course in a friendly spirit, of the specimens that were passed around this afternoon, that you couldn't distinguish after it once covered as to whether one was better than another.

Now the value of this, I think, is shown in this way. A lot of work and a lot of trouble is involved to make actual throwing power measurements the way Mr. Farber did in this long investigation, to actually weigh the plates before and after and measure the currents exactly and measure the cathode efficiencies. That is a lot of trouble. It was worth while in order to get definite figures. Now, having gotten those figures and compared them with what we got with the bent cathodes, then if you will carry the bent cathode test out in exactly the same way as it was carried out here, all you have to do is look at the bent cathode and say, "That is a —50 per cent throwing power," or "That is a —75 per cent or —25 per cent throwing power." In other words, this bent cathode test becomes as nearly as you can judge by looking at it, an actual measure of the throwing power of the solution. So it is interesting to know that that was one of the very last things that we did in this investigation; in other words, Mr. Farber had gotten his results on throwing power—we felt that they were right, but we didn't know whether you would believe it or not, and so we made up all these bent cathodes just to prove, first to ourselves, and then to you people, that these results on throwing power actually mean what they say, because that bent cathode certainly represents a typical, even though a simple, case of plating any irregularly shaped article. So I felt it was worth while emphasizing because it means a new tool in

the hands of the plater.—A bent cathode test, standardized quantitatively so it actually gives you practically a method of determining throwing power.

MR. J. HAY: Mr. Chairman, I would like, if time would allow, just to illustrate how cleaning affects the throwing power of a chromium solution, regardless of the composition of the chromium bath. If you will allow me, I would like to illustrate on the blackboard.

(Draws diagram of electric cleaner, as follows:)



For instance, this is our tank. (I am talking about cleaning strictly, now, gentlemen.) We have a conveyor, and we are operating this cleaner at 7 volts. An alkali cleaner, using the tank as the anode and the conveyor and head lamps as your cathode. Now through the current passing from one of those head lamps (at top of conveyor) to the other one (directly opposite), the effect is, through, I believe, arcing through the screw holes, that it turns the metal there electro-positive from electro-negative, and then this part (indicating outside of lamp around screw hole) will not plate.

DR. BLUM: What are they?—Steel?

MR. HAY: They are brass. I don't know exactly what happens, although it was explained to me once.

Now in order to eliminate that, we changed the position of

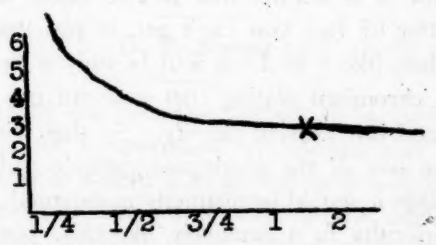
the head lamps and faced them the other way (indicating a half turn of the articles) and we have obtained good throwing power, plating them 100 per cent.

DR. BLUM: Well, in your electrolytic cleaner, Mr. Hay, it is possible those parts were shielded so that you got very little current there, so that you are doing very little electrolytic cleaning on that part.

MR. HAY: I was under the same impression, and changed the head lamps so they were exactly opposite to the way they were at first, but the same thing held true.

MR. HOGABOOM: In the work that Mr. Farber has done, in the throwing power box, does he have the same condition as would be had in a plating solution? In the paper that was read this afternoon, written by Mr. Rowe, he states that he gets his best results by having an anode ratio of 3 to 1 of the cathode. If you are attempting to get throwing power with that ratio of anode to cathode, and then you attempt to measure throwing power with a throwing power box, are you getting results that will be reproducible in commercial practice?

Then, again, in his results, where he gives a definite voltage, the voltage used is materially affected by the relation of the anode to the cathode. Now, if we plot volts like this, 6, 5, 3, 2, 1 (drawing on blackboard), and we plot here anode area ratio to cathode, and have here ¼, ½, ¾, 1 and 2, the result will be this: Draws as follows:



If you have one-quarter of your anode to your cathode to get a given current density, say 150 amperes per square foot, and having a solution of 250 grams of chromic acid per liter, you will have to use about 6 volts, but if you have it here (marks x on curve) why you will only have to use probably about 3.6 to 3.8

volts. So that the relation of the anode to the cathode has a material effect upon the voltage, and when we use anything like that throwing power box, and then compare it with the actual conditions where it is known that you get a better plating condition by having a ratio of say 3 to 1, then is that reproducible.

DR. BLUM: Mr. Hogaboom thought things were getting entirely too tame around here; there wasn't any argument. I am going to take the liberty of speaking for Mr. Farber; perhaps I can cover it more rapidly. The first question that was asked was regarding the relation of the anode and cathode areas in the box with respect to throwing power. Now the thing that we want to emphasize, and I am very glad that it has been brought out in the discussion, is that these measurements of throwing power are simply comparative measurements. In other words, they do not tell you what the throwing power will be on any object plated in any position, in the plating tank, but they simply tell you that if you have one condition in the plating tank, with a given article, and you change that condition in a certain direction, whether you change the temperature, current density, sulphate ratio or anything else, that you will change the throwing power in a certain direction, and of a certain magnitude. In other words, these questions of the shape and size of the anode and cathode are all taken care of in the primary ratio, that is, they determine whether your current is more or less uniform over the article that you are plating. We have adopted arbitrarily here in all of these figures, a ratio of 2 to 1. Now that 2 to 1 we use because it is a ratio that can be rather easily obtained, and as a matter of fact you can't get, if you use a ratio much larger than that, like 5 to 1—it will be only a very few sets of conditions in chromium plating that you can get a deposit both on the high and low current density. So that with respect both to the relative size of the anode and cathode and to the values given for voltage it should be distinctly understood (and of course that is the difficulty in a summary like this, you can't go into detail), that these voltages only apply to that box. But the point is this: that if in one case the voltage in the box is 5 volts and in another case it is 6 volts, then you can be perfectly sure that if you have a tank—I don't care what size it is, or what shape the anode or cathode is, or the size at all—that in one condition it is going to take a greater voltage than in the other condition.

In other words, we don't want you to think for an instant that because this table says it used 6.4 volts, that it is going to take you 6.4 volts to plate a certain thing. You might do it at 3 volts or you might do it at 10, depending entirely on the position and shape and size of your electrodes, and that is one of the reasons that in this outline we emphasized the fact, and that was brought out very splendidly in that paper of Mr. Rowe's this afternoon, of which I only heard a part, that the biggest problem in chromium plating is the mechanical ingenuity to get the current where you want it.

Now that has nothing to do with throwing power as we have defined it. In other words, that is getting the best you can first in current distribution. Then we tell you afterwards, after you have done that, how you can get the best throwing power for a given current distribution. I think that answers the question.

MR. HAY: I would like to say that Dr. Blum hit the nail right on the head when he said that. I just want to tell the boys here tonight that it is very important to watch all the conditions before you get to the chromium bath, because the chromium bath itself is not as peculiar as most of you think it is, but the conditions of the operations before you get there are more important and have more to do with it than the chromium bath itself.

SOME CAUSES OF RESISTANCE IN CHROMIUM PLATING SOLUTIONS

D. T. Ewing

The first part of the investigation which is covered in this paper, deals with the measurement of resistance of solutions of chromium tri-oxide in water. The second deals with the measurement of the resistance of a solution of chromic acid, 250 grams per liter, to which has been added various amounts of addition substances, usually sulphates, such as those of iron, chromium, trivalent chromium, and the alkalies, as well as chromium hydroxide. In the third place, solutions taken from commercial baths have been dealt with. These solutions in some cases are quite new. Some have been in operation several years.

The object in working with these solutions, whose resistance

has been built up, is to devise means, if possible, for efficiently increasing the conductivity. That is, the first part deals more with some of the fundamentals of synthetic solutions which we know of course are not quite the kind we deal with in commercial work, because electrolysis changes it a great deal, we know. But we hoped we might obtain some information from these synthetic solutions which would help us to explain some of these other effects which are met with under certain conditions.

The operators have made these measurements simply with an automatic conductivity set-up with perhaps one or two features I might mention; otherwise there is nothing especially new.

Slide No. 1. The cell is, as a matter of fact, not quite the same cell which we have pictured here, in so far as there is an orifice at the lower part, and at the under part we have two side arms serving a dual purpose. That is, this cell may simply be immersed in a solution of chromic acid which is to be sampled and the solution runs up past the electrodes and the two arms here serve as a support for the cell against the walls of the beaker. The bridge we used is a modern potentiometer, using the slide wire part with only the phones at the point of contact and between the variable resistance and the conducting cell. Here (at the left of slide) you see a transformer and an audion tube. We found there was some advantage in using that set-up in so far as there is no external noise, the only signal being that received through the phones.

Slide No. 2. Some of the salts we have obtained—in this case we have taken chormic acid in varying amounts, from 50 grams per liter up to about 500. The conductivity, of course, increases and reaches a maximum at about 450 grams per liter. After that, there is a tendency to fall down; it has become saturated, and results were not carried further.

Now after we had studied this effect, using very pure chromic acid which is quite free from sulphate and other impurities, we decided to take 250 grams per liter of solution, and add various amounts of other substances, the results of which are shown in the next slide.

Slide No. 3. We are here rather close to the sulphates because that seems to be the favorite addition for baths, as generally used, and first we have an alkali sulphate, sodium sulphate. Contrary to what is oftentimes said of the addition of these salts to chromic acid solutions in order to increase conductivity, it is not quite the

correct thing, I think. The conductivity does not change a great deal upon the addition of the sulphates, only slightly in these units, perhaps 25 to probably 33. Of course, the efficiency does change a great deal, and that is the thing which changes, rather than the conduction.

Again, ferric sulphate is added. The result is not very different.

We tried next chromium sulphate, which is used a great deal—trivalent chromium—and the resistance is changed much more.

Then we tried using chromium hydroxide, having a neutralizing effect upon the chromic acid; and bichromic acid, and so on, and we find of course the resistance changes very fast, very much faster compared with the substances of this type (indicating sodium sulphate).

Then, another iron salt was used, namely ferrous sulphate. The effect is entirely different from that of ferric sulphate. We rather expect that when we consider the chemistry of a mixture containing chromic acid, for instance, and ferric sulphate, especially when it is heated. The explanation, of course, between the difference of effect of these is undoubtedly the ferrous iron reacts with the hexavalent chromium, and builds up a resistance, for two reasons, serving in a sense a double effect, in so far as chromic acid is removed from the solution, having combined with trivalent chromium, and forming partly a colloid, and it is hard to tell exactly what all is formed there due to the presence of certain combinations. Then the ferrous sulphate acts as chromium hydroxide, due to the fact of the removal of chromic acid, in solution, and also the addition of another compound which builds up resistance.

Now these results have been expressed as obtained in the laboratory on a modified Kaulrausch conductance apparatus. The next slide shows the same thing.

Slide No. 4. Sodium sulphate, of course, decreasing the conductivity at this point (pointing); here you can see the result of ferric sulphate, chromic sulphate, chromic hydroxide and ferrous sulphate.

The work that followed this was a case where we took certain commercial plating baths, some of which were new, and some of which were rather old, a couple of years, in some cases, and studied the effect of electrolysis upon the resistance of these solutions by placing them in a smaller cell, divided into two compartments, one the analyte and the other the cathalyte, and followed

the effects by making these bridge measurements. Of course, when we start the new solutions, the analyte does not change, the resistance is not lowered, but the resistance of the cathalyte increases very fast. Using an old solution, one in which the resistance is 200 per cent larger than normal, we find just as we expect in the analyte, oxidation. Trivalent chromium takes place quite fast, apparently reaching an equilibrium point, and in the cathalyte the resistance builds up very much faster than it is reduced in the other compartment. That would mean, of course, as has been stated by some in the literature, that one may use a small compartment about the cathode which is readily removed from a large solution, and carry out the electrolysis, and thereby change this ratio in our favor, that is, reducing the resistance at the analyte, and in the cathalyte building up very fast with that solution of which only a few gallons is discarded. The addition agent is taken care of, no correction need be made for that because if the porosity of the membrane is properly selected, the sulphates migrate in this case and are not removed from the solution.

So then I would say in conclusion that the conductance of the chromic acid solution, chromic acid and water, seems to reach a maximum at about 450 grams per liter. As we add varying amounts up to 30 grams in a liter, 35, of various substances, we find the effect is practically continuous, and is most noted in those cases which of course tend to build up trivalent chromium.

EDITOR'S INQUIRY

Branch Secretaries: What happens to all the questions and answers given and asked at Branch meetings? Why not give the membership at large as well as your own members who can not be with you every meeting a chance to read them in your REVIEW?

LOS ANGELES BRANCH

Speech at L. A. Branch of the A. E. S. October 9, 1929, by M. D. Rynkofs, Sec.-Treas., L. A. Branch

Brother President, Brother Members and Visitors:

With such a wonderful gathering here tonight to celebrate the granting of a permanent charter to the L. A. Branch, better known as the Baby Branch of the A. E. S., I would like to thank you for showing your interest in responding to our efforts for this occasion.

All this rush and bustle reminds me of what a refined lady told me not so long ago. I refinished a brass bed for her, delivered and set it up. She asked, "How long will that finish last?" I answered, "Lady, I stand back of every bed that I refinish." And she said, "Say, Mister, you're working fast."

Subject—"Whither Are We Drifting?"

I am informed that electroplating has been practiced in Los Angeles since about 1890. This would establish the fact that this industry has kept pace with the growth and development of other industries in this territory. It would also indicate that in the next 10 years to come, the development of this industry will undoubtedly be as rapid in this territory as in any section of the whole United States. However, in the past fifteen years or more there have been different organizations formed in Los Angeles with some very interesting meetings, but somehow, confidence and co-operation was lacking or soon lost, failure resulting.

At several of these meetings, which were most always informal as to keeping the minutes and records, we had the highest type of organizers present, trying to get a job, asking from $5,000 to $10,000 a year to establish a local electroplaters' association for the good of the plating industry.

So this branch got its start when a small group of platers and visitors attended a meeting held on January 7, 1929, at the Elite, at which time it was decided to pray for a temporary charter and become affiliated with the American Electro-Platers Society. Since that time the Los Angeles Branch has shown its progress, that it is the ninth branch of the A. E. S. with 60 members (as you heard that number mentioned in today's minutes). We should have 75 members right now which would put the Los Angeles Branch where it belongs, namely, fifth place, exceeded only by Chicago, Philadelphia, New York and Newark.

There are 60 more names who will qualify on the prospective list and, if each one of us can secure only one new member, Los Angeles can easily attain this goal. We are not making a drive for membership this evening, but we are all interested in having our branch as near the top as possible.

There is no doubt, that the knowledge and information received at these meetings cannot be weighed in dollars and cents, not to lose sight of the value of the Monthly Review, which contains the essence of information from the very best platers in the country. Also not to

overlook the fact that at these meetings the foremost minds of the industry on the Pacific Coast make use of thought, word and deed.

This society consists primarily of men who are anxious to improve their craft and knowledge, otherwise they would not join. It also consists of two classes: foremen platers and job platers. The foreman is benefited, because not only of the knowledge gained, but also by the exchanging of that knowledge with other platers and getting their views in return. The job plater benefits also from accrued knowledge, but he benefits considerably by his social contact with his contemporaries, which in time is bound to bring results by helping to eliminate the sometimes absurd competitive spirit eventuating in a better understanding—thus, developing a friendly and brotherly feeling of each other.

We keep looking forward to greater possibilities as all great organizations must do, that are so welded in commercial greatness of the entire country.

"Knowledge is Power" is the motto of this society, but learning is only valuable when it means actual knowledge, and knowing is only valuable when it means doing, creating, and co-operating by attending every meeting, for, you will not know any less, by knowing your competitor.

Let us all have faith in the future of this society. There are a few eager to retard its progress, yet those who have faith, who believe that right is right, will gain materially. So if we stick to the principles and ideals of the society, we shall always win.

There is nothing extraordinarily new in the art of electroplating, so far as the deposition of copper and nickel is concerned, as the basic factors for a rust proof finished metal surface on steel, satisfactory for a final deposit of chromium as we see such finish today. We have this one subject to rely upon as a discussion at almost every meeting.

No doubt you will agree that chromium plating is still in the development stage. It sounds the passing of all types of platings that may tarnish, stain, rust, corrode, wear or lose their lustre, and provides characteristics long desired by the consumer, but heretofore unknown to the plating industry.

It might be in order at this particular time to suggest that we of the Los Angeles Branch should discuss the advisability of purchasing testing instruments for chromium, copper, nickel and other solutions, enabling the members to know what to expect of their solutions, this to form a nucleus for a library and possible laboratory for our branch. At any rate if we have the instruments we can devote a half hour to testing various solutions at the monthly meetings.

Let us apreciate the fact that this is not a Local Society but a National Organization numbering among its members the best Platers in the United States and Canada, also there has begun affiliation with the Platers in England. The membership also includes some of the best Electro-Chemists of the country, and surely no Plater can afford to miss the opportunity of being affiliated with the best men in his craft —thus, through them, increase his knowledge, and most of all, let him contribute his mite to the good work.

Between meetings, think of the subjects you would like to be brought up, and come to every meeting prepared to ask questions. We would also like to have an occasional volunteer of a paper on some subject. We won't care how elementary the paper is, as even the very best Platers could not do any better when he first started.

Now, in conclusion, the destiny of the L. A. Branch remains with you. The Society grows in number and continually it extends in membership, now numbering 1,350, and has branches from east to west, from Boston on the Atlantic Coast to our city on the Pacific Coast, and it will continue to grow in numbers if we co-operate, one with each other for its welfare. Co-operation is the great big factor in this modern world—and if we continue to co-operate, work in unity and harmony for the upbuilding of the Society, then you will have earned a just and great reward. You will then be a true and loyal member of A. E. S. and all that it represents in these United States.

I thank you.

PITTSBURGH BRANCH

Our members, some of whom do not attend the meetings, only when the Entertainment Committee gets busy with a lunch and smokes, do not know the good things they are missing, and last night was no exception. In response to President Smith's letter for a committee man for the Research Committee, Mr. Thomas P. Thomas was named, he is a research chemist for the Westinghouse Electric & Mfg. Co., and will be a valuable addition to the committee. The members do not want to forget that we are now holding our meetings in Room E, Keystone Club, Third and Wood streets, Pittsburgh, Pa. Next meeting will be held the first Friday evening in December at 8:00 o'clock.

S. E. HEDDEN, Secretary-Treasurer.

BOSTON BRANCH

Boston Branch met Friday at the American House, with Past President Mackie in the chair.

The minutes of the previous meeting was read, bills and communications were read and approved as read.

Mr. Donald Wood was appointed to represent the branch in this district on the Research Committee.

Four applications were received for membership and were referred to the Board of Managers.

After being put over from last May, election of officers took place and all were elected except the Board of Managers, they are the following: Mr. Lee, Mr. Johnson, and Mr. Leach.

The subject for the next meeting will be the measurement of the Ph. of the nickel solution.

After the regular order of business the librarian, Mr. Lee, took the chair and gave a talk on the silver solution, as given at the 1928 convention. A general discussion took place, lasting for more than an hour. The meeting adjourned at 10:30 p. m.

A. W. GARRETT, Secretary.

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

Don't fool away so much time in toil. If you die and go to Heaven you'll have the work habit so bad that you can't enjoy resting. And if you go to Hell you'll regret that you didn't have more fun when you had a chance.

Sentry Duty

The owner of a big plant, addressing a new employee:

"Did my foreman tell you what you will have to do?"

"Yes, sir, he told me to wake him up when I see you coming."—*Forbes Magazine*

Getting Peeled

Wild and disheveled, watery of eye, and trembling of limb, he burst into the dentist's consulting room and addressed the molar merchant in gasping tones:

"Do you give gas here?"

"Yes," replied the dentist.

"Does it put a man to sleep?"

"Of course."

"Nothing would wake him?"

"Nothing. But—"

"Wait a bit; you could break his jaw or black his eye without him feeling it?"

"My dear sir, of course, I—"

"It lasts about half a minute, doesn't it?"

"Yes."

With a war-whoop of joy and relief the excited man threw off his coat and waistcoat.

"Now," he yelled, as he tugged at his shirt, "get yer gas-engine ready. I want you to pull a porous-plaster off my back."—*Credited to "Exchange" by the Christian-Evangelist.*

No Incentive

Employer—"Sam, I hear you and George almost had a fight."

Sam—"Yassah, boss, we all would 'a' had a terrible fracas, only they wasn't nobody there to hold us apart."—*Life.*

Did you hear about the smallest woman in the world? She is so small that she can sit and sew on a button.

Famous Pairs

Hug & Kiss
Neck & Neck
Night & Day
Yes & No
Win & Lose
Free & Easy
Up & Down
Jack & Jill

TORONTO BRANCH

The regular monthly meeting of Toronto Branch was held in the Canadian Foresters' hall, Monday, Oct. 28, at 8:00 p. m., President J. Walker presiding.

We had a fair attendance, including some of our members who had been absent for the last few meetings. Following the reading of the minutes, bills and communications were presented. The matter of the donation to the Research Fund was left over till next meeting.

It was reported that the attendance at the platers' class held in Central Technical School was fifteen members, including one lady. Following this, the Question Box was held, and at the close of which the meeting was adjourned at 10 o'clock.

H. WM. GRAHAM, Secretary-Treasurer.

ST. LOUIS BRANCH

We had a very good attendance at our meeting of Nov. 8th. Our good Secretary, Chas. McGinley, has been absent two meetings on account of sickness. President Riefling presided.

Our Banquet Committee, E. J. Musick, reported having arranged to have our **Annual Meeting at Hotel Chase on Jan. 25, 1930.** This gives us larger and more attractive facilities.

There will be Educational Session in afternoon, followed by dinner and dance in evening.

Our meeting was then turned over to Librarian Siemers. Several questions and subjects were discussed. It left no time for our usual class address by Dr. Stout.

Mr. Paul Miller of Evansville, Ind., was present.

H. H. WILLIAMS, P. P., Correspondent.

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch, A. E. S., held its regular monthly meeting on Monday evening, Oct. 28, 1929, at the Chamber of Commerce room, Springfield, Mass.

The meeting was opened with President Belum in the chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file.

As we had no speaker for the evening, the time was spent in the discussion of plating problems. One of the members showed samples of work that had been tin-dipped and then silver-plated. One member wanted to know the proper procedure to strip chromium and nickel from die castings without injury to the casting. Any assistance on the topic will be appreciated. There was much discussion on the value of research, also some discussion on articles read from the Convention Proceedings. One article in particular, that of the offer of the Brass World, through Mr. Trumbaur, to take over the publication of "The Monthly Review" for the Supreme Society, aroused much interest.

After much discussion, the general census of opinion seemed to be in favor of the offer.

The meeting was well attended by twenty-six members and visitors, and was adjourned at 10:15 p. m.

V. E. GRANT, Secretary.

CLEVELAND BRANCH

The November meeting of Cleveland Branch was the most enthusiastic meeting that this branch has had since it started, at least to the writer's knowledge.

There seemed to be an interest in everything that was said or done and we appointed a membership committee to look after new members and also delinquents and try to get them back in the fold.

We also appointed Mr. Cyrex on the Research Committee from this district.

We are working on a method of scientific control so simplified that anyone can understand it, and use it without spending much time at it, and we are being supported by our entire membership with an enthusiasm that cannot mean anything but success.

We are also going to have a Smoker, Jan. 18, at Socialer Turn Verein, at which we are going to have a big time, and forget plating and its troubles, but just enjoy ourselves. We hope that our last meeting will be duplicated in enthusiasm, attendance and good feeling, as we are going to carry on this research until we have a simple cure for all plating room troubles, and it may take some time.

H. J. TERDOEST, Secretary.

NEWARK BRANCH

The regular meeting of the Newark Branch A. E. S. held at 41 Bank street, Newark, N. J. The meeting was called to order by Vice-President Calabrese at 8:30 p. m.

Vice-President Calabrese dispensed with the regular order of business and introduced the speaker of the evening, Mr. George Hogaboom, who then introduced Dr. E. B. Sanigar of Birmingham, England, who is to undertake electroplating as the first western fellow of the American Electro Chemical Society at Columbia University under Dr. Fink. Dr. Sanigar, after brief words thanking the members for their kind reception and was very glad to be present and did not expect to speak, he came here to hear Mr. George Hogaboom speak. Mr. Hogaboom then called upon Dr. Pan of New York University and New York Branch to say a few words, and Dr. Pan responded splendidly, after which Mr. George Hogaboom, the speaker of the evening, whose subject was "Brass Plating," a subject in which we are all very much interested, which was accompanied with lantern slides. A few points brought out in Mr. Hogaboom's talk as seen by the Secretary-Treasurer were: A Brass Solution should not be run at more than 2.6 amperes per sq. ft.,

or a brittle deposit is obtained. Brass anodes of anneal 80-20 should be used with a cyanide content about the same as the copper content. Temperature 100 F. Ammium chloride detrimental to brass solution. In running brass solution, look out for zinc. Carbonates in brass solutions give a variety of results. Solutions that contain up to 8 oz. of carbonates work well over and up to 16 oz. fair and after 16 oz. not so good, and give coarse crystal deposits. Anodes remain bright up to 8 oz. of carbonates. Anodes acquire dull appearance up to 12 oz. Ammonia should be added from time to time and seems to combine cu. and zn. A rising vote of thanks was given Mr. Hogaboom.

Mr. MacStoker, Past President of New York Branch, headed a delegation of New York members and was called upon to give a talk, and responded as no one but Mr. MacStoker can.

Last but not least, one of our old-timers, Mr. E. Faint, now working in Allentown, Pa., gave in his brief but well-put talk of his experiences.

After Mr. Faint's remarks, a letter from the Research Committee was read, asking all members, each and everyone, to send in his returned postal card which he will get soon.

Meeting adjourned at 10:15 p. m., after which refreshments were served.

GEORGE REUTER, Secretary-Treasurer.
Newark Branch, A. E. S.

CHICAGO BRANCH

Regular monthly meeting of Chicago Branch A. E. S. held Saturday, Nov. 9, 1929, at the Atlantic Hotel. Meeting was called to order with President S. J. C. Trapp presiding, and all officers present.

We had a fine lot of discussions, especially Mr. C. F. Nixon's article, "Corrosion of Chrome Plate," in the Sept. Review, which again was the subject taken by our instructor, Mr. H. Faint.

The Banquet Committee reports progress; the banquet will be held Jan. 18, 1930, in the Red Lacquer Room of the Palmer House. The whole society is invited to attend this meeting. Fine papers will be read.

J. C. KRETSCHMER, Secretary.

PHILADELPHIA BRANCH

Regular monthly meeting of Philadelphia Branch was called to order by the President, W. M. Scott, Nov. 1, at the University of Pennsylvania.

The attendance was good. The largest part of the evening was taken up by the report of the Banquet Committee, who reported prospects of a record attendance.

O. W. Mott was the speaker of the evening, who gave an interesting talk on "Gold Plating and Finishing of Silverware." Mr. Mott being

a veteran in this line of work, amused the younger members in his recital of how the work was handled in former years.

PHILIP UHL, Secretary-Treasurer.

DETROIT BRANCH

Detroit Branch held its regular meeting, Friday evening, Nov. 1, at the Hotel Statler, President B. F. Lewis presiding.

The reading of the minutes of previous meeting were dispensed with, due to the lengthy program of Educational Committee.

The chairman of the Educational Committee, Mr. Jameson, introduced the speaker of the evening, Mr. Stocker, who gave an interesting talk on the "Calculation of the Thickness of Deposit of Plate to Meet Specifications." Mr. Jameson gave a talk on the "Determination of Free Cyanide in a Cyanide Copper Bath." The meeting closed with the customary Question Box, and was well attended.

CHAS. M. PHILLIPS, Secretary-Treasurer.

BOSTON BRANCH

Boston Branch met Friday, Nov. 8, at the American House, with President Gale in the chair.

Minutes of the previous meeting read and approved, communications and bills read, approved, and bills paid.

A request for funds from the Research Committee was read and the Secretary was instructed to send a check for $50.00.

Four applications for membership were presented by the Board of Managers.

An error made at the meeting of Oct. 18, which stated that all officers had been elected; but it should have been that the Board of Managers were to act as a committee, to bring a list of names for election to office at this meeting and the following names for office were brought in, and under the suspension of the rules the following: President, Louis A. Gale; Vice-President, Charles O. Hardy; Recording Secretary, Thomas Johnson; Financial Secretary, Andrew W. Garrett; Board of Managers, Thomas Johnson, Chairman; Bart F. Lee, and George C. Leach; Librarian, Donald Wood; Sergeant-at-Arms, Joseph V. Dufresne.

Hereafter Boston Branch will meet on the first Thursday of the month at the American House, Boston.

It was suggested that the branch form a chemistry class in the near future.

One of the members, Donald Wood, has invited the members to come to his place of business where he has a laboratory, where the members can work out any problems that they might have, and his invitation was accepted with thanks.

The subject for the next meeting will be the same as this meeting, the measurement of the Ph. of the nickel solution.

After the regular order of business, the librarian, Mr. Lee, gave the talk on the Ph. of nickel solution by the comparator and was very interesting, and a good discussion took place until the meeting adjourned at 10:30 p. m.

A. W. GARRETT, Secretary.

RESIGNED	Branch
James F. Spaine	Bridgeport

SUSPENSIONS	Branch
J. M. Rushmara	Rochester
Victor H. H. Borg	Rochester

DEATHS	Branch
E. J. Hollis, Navy Yard	Baltimore-Washington

APPLICATIONS	Branch
Jas. Francis Kelly, Westinghouse Elec. Mfg. Co., East Pittsburgh, Pa.	Pittsburgh
Clarence M. Beckett, 329 George St., Turtle Creek, Pa.	Pittsburgh

ELECTIONS	Branch
Dr. A. H. Fiske, Rumford Chem. Wks., Rumford, R. I.	Prov.-Attleboro
O. B. Kirchoff, 16 E. 5th Ave., Jamestown, N. Y.	Rochester
J. A. Kushner, 440 Parkdale Ave., Buffalo, N. Y.	Rochester
J. J. Callahan, 1006 N. State St., Syracuse, N. Y.	Rochester
Jos. V. Dufresne, 40 School St., Sommerville, Mass.	Boston
Wm. A. Lawrence, 37 Wachusett St., Forest Hills, Boston, Mass.	Boston
Thos. A. Reardon, 100 New Park St., Lynn, Mass.	Boston
Eric Rylander, 39 Frank St., Watertown, Mass.	Boston
A. J. Strauss, 298 Union St., Belleville, N. J.	Bridgeport
Wm. Betz, 105 Franklin Ave., Maplewood, N. J.	Newark
Wm. H. Terrance, 726 Bloomfield Ave., Glen Ridge, N. J.	Newark
D. X. Clarin, care Oakite Prod. Inc., 22 Thames St., N. Y. C.	Newark
H. R. Treating, 885 Lake St., Newark, N. J.	Newark
J. H. Benz, 7109 Upland St., Homewood, Pa.	Pittsburgh
B. M. Griffith, 1601 Reedsdale St., N. E. Pittsburgh, Pa.	Pittsburgh
Milo. J. Stutzman, 2801 Preble Ave., Pittsburgh, Pa.	Pittsburgh
L. A. Maassen, 1954 W. Pratt St., Baltimore, Md.	Baltimore-Washington
C. C. Ferguson, 415 Third St., N. W. Washington, D. C.	Baltimore-Washington
Peter Balick, 9 Miller St., Westfield, Mass.	Hartford-Conn. Valley
Milton Whitmore, U. S. Army Air Corps, Materials Br., Wright Field, Dayton, Ohio	Dayton
Wm. E. Daugherty, 416 North St., Auburn, Ind.	Dayton
H. M. Blum, 78 Brighton Ave., Highland Park, Mich.	Detroit
Paul Downs, 17130 Gallogher Ave., Detroit, Mich.	Detroit
Wm. H. Downs, 5721 Missouri Ave., Detroit, Mich.	Detroit

BALTIMORE-WASHINGTON

Meets in Enoch Pratt Library, Calhoun and Hollins Sts. Geo. F. Turner, Secretary, 5324 Maple Ave., Pimlico, Baltimore, Md.

BOSTON

American House, Boston, Mass. First Thursday each month. Secretary A. W. Garrett, 45 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Friday of each month at 62 Cannon St., Room 17, Bridgeport, Conn. Secretary, Wm. Ehrencrona, Box 301, R. F. D. No. 1. Bridgeport, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St. Secretary, J. C. Kretschmer, 1914 Warner Ave.

CINCINNATI

Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty St. Secretary, Al. Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton. H. Terdoest, 180 Pioneer Ave., Akron, Ohio.

HARTFORD-CONN. VALLEY

Meets fourth Monday in each month alternately at 266 Pearl St., Hartford, Conn., and corner Broadway and Worthington St., Springfield. Secretary, Vernon Grant, 43 Putnam St., Bristol, Conn.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Robert G. Suman, 2734 Ridge Road, Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler, Louis II Room, Detroit. Secretary, Chas. Phillips, 13421 Camden Ave., Detroit, Mich.

GRAND RAPIDS

Meets on the second Friday of each month at 528 Lake Michigan Drive, N. W. Secretary, Jacob Van Dyke, 1361 Union Ave., N. E., Grand Rapids, Mich.

INDIANAPOLIS

Meets the second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

LOS ANGELES

Secretary, M. D. Rynkofs, 1354 W. 25th St., Los Angeles, Calif.

MILWAUKEE

Meets second and fourth Thursdays of each month at Cor. 3rd St. and Highland Ave. J. N. Hock, 1229 W. 24th St., Milwaukee, Wis.

MONTREAL

Meets last Friday of month at Office of Secretary, John H. Feelay, 411 Aylmer St., Montreal, Quebec, Canada.

NEWARK

Meets first and third Fridays of each month at Franklin Hall, 41 Franklin St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Geo. Rueter, P. O. Box 201, Newark, N. J.

NEW YORK

Meets every second and fourth Fridays of each month in the World Building, Park Row, New York City, N. Y. Secretary-Treasurer, J. E. Sterling, 2581 46th St., Astoria, L. I.

PHILADELPHIA

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, P. Uhl, 2432 North 29th St., Philadelphia, Pa.

PITTSBURGH

Meets first Friday of each month at 8 p. m., at downtown branch, Y. M. C. A. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third Thursday of each month at 44 Washington St., Prov. Engineers Rooms, Providence, R. I. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets every third Friday of each month at the Powers Hotel. Secretary, Chas. Griffin, 24 Garson Ave., Rochester, N. Y.

ST. LOUIS

Meets second Friday of each month at Central Y. M. C. A., 16th and Locust St. Secretary, C. T. McGinley, 8214 Fairham Ave., University City, Mo.

TOLEDO

Meets first Thursday of each month at Toledo Secor Hotel, corner Cherry and Page Sts. Secretary, W. W. Welker, 2228 Middlesex Rd., Route 2, Box 635, Toledo, Ohio.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, H. W. Graham, 102 Robina Ave., Toronto, Canada.

WATERBURY

Meets every second and fourth Thursday of each month. Secretary, Wm. F. Guilfoile, Garden Theatre Bldg., East Main St., Waterbury, Conn.

WORCESTER

Meets Directors' Room, Chamber of Commerce, Worcester, Mass.

1928-1929

Roger H. Bryant, Secretary, 94 Grove St., Worcester, Mass.